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XXXV.—*On* Callograptus radicans, *a new Dendroid Graptolite.* By JOHN HOPKINSON, F.G.S., F.R.M.S.

[Plate X.]

THE genus *Callograptus* belongs to a group of organisms which are frequently classed with the Graptolites, but which present sufficient points of difference to warrant their separation as a distinct sub-order, for which the name DENDROIDEA has been proposed by Prof. H. A. Nicholson. In it are included the genera *Ptilograptus*, *Dendrograptus*, *Callograptus*, and *Dictyonema*. These forms, while nearly allied to each other, differ considerably from the true graptolites. The slender chitinous rod or "virgula," from the invariable presence of which in the true graptolites Prof. Allman has recently proposed for them the name RHABDOPHORA, is not present in these forms; and the slender "radicle," forming in the true graptolites the proximal termination of the virgula, is also absent. The DENDROIDEA, all of which are branching forms, differ also from the RHABDOPHORA in their mode of branching, and there seems to be a slight difference in their hydrothecæ.

There is yet another and a very important point of difference between the two groups. The new species of *Callograptus*, which I propose to name *C. radicans*, seems to furnish conclusive evidence of the fixedness of the forms to which it belongs, while the slender tapering radicular process of the Rhabdophora shows that they could not have been similarly attached to foreign bodies.

CALLOGRAPTUS agrees with its near allies, *Dendrograptus*

and *Dictyonema*, in having "a common trunk or stem, or growing in sessile groups of stipes from a common origin, without distinct bilateral arrangement of the parts," and also in having its hydrothecæ "in single series on one side of the stipes or branches, and arranged along a common canal or axis," and differs from them in having its branches "unfrequently and irregularly connected by transverse processes" (Hall).

Callograptus radicans has *a diffuse flabelliform polypary, with an elongated erect and robust hydrocaulus, terminating proximally in a spreading fibrous hydrorhiza.* The polypary, in the only specimen in which this rooting termination or hydrorhiza has been seen, is at least six inches long; and its extreme width, where the branches terminate distally, appears to have been about the same. The hydrorhiza covers a space about half an inch square, but is very irregular in shape. It appears as a series of interlacing or anastomosing fibres which must have formed a kind of network over the surface to which it adhered. The hydrocaulus or main stem is about 1-10th of an inch in width at its junction with the hydrorhiza, increasing to twice this width where the first indication of branching occurs, its length between these two points being exactly one inch. It has a striated surface and an irregularly crenate outline. The branches bifurcate frequently and continuously throughout their length, diverging only slightly at first; but after the first few bifurcations the whole polypary rapidly widens out, and towards its distal extremity the branches frequently diverge from each other at a wide angle. They vary from 1-50th to 1-30th of an inch in width, but, being much compressed, must have been originally of greater tenuity. They frequently anastomose; but this, as in *C. Salteri*, Hall, does not appear to be a constant character. Unfortunately the state of preservation in which this species occurs does not allow the form of its hydrothecæ to be distinctly made out. Some of the branches show minute oval impressions arranged in a single series along their centre, the longer diameter or major axis of the oval being parallel with the margins of the branches. These impressions, of which there are about twenty to the inch, most probably indicate the apertures of the hydrothecæ.

This species is very distinct from the two previously described species of *Callograptus*. It is much larger and more robust in all its parts than *C. elegans*, Hall; and its branches originate from the main stem in a very different manner. To *C. Salteri*, Hall, it is more nearly allied; but its branches bifurcate in a more irregular manner than in that species, they

have not the same zigzag direction, and the whole polypary is more diffuse and irregular in form.

But the distinctive feature in the specimen of *Callograptus radicans* described above is its possession of a hydrorhiza, or rather, I should perhaps say, the *preservation* of its hydrorhiza; for the presence of this organ in a single specimen of one species should suffice to prove its former presence in all —to show, in fact, that it is an essential organ of the genus *Callograptus*.

From the imperfect manner in which these Silurian fossils are usually preserved, we cannot wonder that a delicate organ, whose function it was to attach to some other substance the more durable portion of the organism of which it formed a part, has not before been found in connexion with this portion. None of these dendroid graptolites has yet been found attached to any other body. Their proximal termination is usually imperfect, and often has an irregular margin as if it had been broken. Such fracture, when the polypary was severed from the substance to which it was attached, would most easily take place at the junction of the hydrocaulus with its hydrorhiza.

In the rocks in which graptolites occur, other fossils are seldom found; but in the graptolite beds from which this specimen was obtained a large *Conularia* (*C. Homfrayi*) abounds, and in a thin zone in which this and other species of *Callograptus* and *Dendrograptus* occur in profusion it is especially abundant. Upon this *Conularia*, which is sometimes covered with graptolites, and also upon other fossils which are occasionally associated with it, some of these dendroid forms may perhaps have grown; but no connexion has yet been clearly seen.

We are not without evidence that the other genera of the Dendroidea were similarly attached to foreign bodies or to the sea-bottom. Even if this were wanting, these dendroid graptolites are so nearly allied to each other (*Callograptus* forming an intermediate link between *Dictyonema* and *Dendrograptus*, to which also *Ptilograptus* is nearly allied) that we might safely have inferred that the mode of existence of all these forms was the same. But the genus *Dendrograptus* has already furnished evidence of the fixedness of these dendroid forms. Professor James Hall, after expressing his belief that the *true* graptolites "in their mature condition were free floating bodies in Silurian seas," thus treats of the mode of existence of the *dendroid* graptolites:—

"In regard to another group, including *Dendrograptus*, *Callograptus*, and *Dictyonema*, as well as one or two other

forms, we have some evidence indicative of a different mode of existence. The stems of *Dendrograptus* are enlarged towards their base, and sometimes present a sudden expansion or bulb, which I have inferred may be the base or root, once attached to another substance, or imbedded in the mud or sand of the sea-bottom." . . . . . "In those which I have termed *Callograptus*, the bases of the fronds are imperfect, but indicate, according to analogy, a radicle or point of attachment like *Dendrograptus*. In the more nearly entire forms of *Dictyonema* known, we have not been able to observe the base; but, from their similarity in form and mode of growth to *Fenestella* and *Retepora*, we have inferred their attachment either to the sea-bottom or to foreign bodies." (20th Rep. New-York State Cab. Nat. Hist., p. 238, ed. 1870.)

The bearing of this on the question of the systematic position of the Dendroidea alone remains for consideration. It has already been shown that the Rhabdophora differ from our recent Sertularian Hydroida only in their possession of a slender rod or virgula, and in their having apparently been free. The Dendroidea offer no such points of difference, being essentially similar to the recent Sertularian zoophytes in their mode of growth, as well as in their general form, and, as far as their imperfect state of preservation enables us to determine, in their intimate structure also. On this last and most important point, however, we have no certain knowledge: while we know of no characters whereby the Dendroidea can be separated from the Hydrozoa, we are equally destitute of decisive evidence of their structural difference from the Polyzoa; nor can we wonder at this when we consider how long these two classes were grouped together under the general term of Zoophyte or Coralline.

Dictyonema certainly seems more Polyzoan than Hydrozoan in its affinities, while *Ptilograptus*, on the other hand, seems to be far more nearly related to the Hydrozoa than to the Polyzoa; and analogy with the true graptolites, which are certainly Hydroids, would lead us to infer that the Dendroidea have the same internal structure as they have. If this should prove to be the case, the genera *Ptilograptus* and *Dendrograptus* would fall naturally into families already existing in the sub-order Thecaphora (or Sertularina), while for *Callograptus* and *Dictyonema*, which have their branches more or less regularly connected together by transverse processes, a new family would have to be instituted. At present we do not know of any tangible character whereby the Dendroidea, considered as a single group, can be separated as a distinct sub-order from the Thecaphora. In the mean time the term *Graptolite* may

still be used as a general term for all the forms to which the name has been applied, as the term *Zoophyte* was formerly used for such different beings as the Hydrozoa, the Actinozoa, and the Polyzoa.

EXPLANATION OF PLATE X.

Callograptus radicans, Hopk., natural size. Photo-lithographed from a specimen collected by the author in the Arenig rocks, Ramsey Island, St. David's, South Wales.

XXXVI.—*The Mollusca of Europe compared with those of Eastern North America.* By J. Gwyn Jeffreys, F.R.S.*

After mentioning that he had dredged last autumn on the coast of New England in a steamer provided by the Government of the United States, and that he had inspected all the principal collections of Mollusca made in Eastern North America, the author compared the Mollusca of Europe with those of Massachusetts. He estimated the former to contain about 1000 species (viz. 200 land and freshwater, and 800 marine), and the latter to contain about 400 species (viz. 110 land and freshwater, and 290 marine); and he took Mr. Binney's edition of the late Professor Gould's 'Report on the Invertebrata of Massachusetts,' published in 1870, as the standard of comparison. That work gives 401 species, of which Mr. Jeffreys considered 41 to be varieties and the young of other species, leaving 360 apparently distinct species. About 40 species may be added to this number in consequence of the recent researches of Professor Verrill and Mr. Whiteaves on the coast of New England and in the Gulf of St. Lawrence. Mr. Jeffreys identified 173 out of the 360 Massachusetts species as European, viz. land and freshwater 39 (out of 110), and marine 134 (out of 250), the proportion in the former case being 28 per cent., and in the latter nearly 54 per cent.; and he produced a tabulated list of the species in support of his statement. He proposed to account for the distribution of the North-American Mollusca thus identified, by showing that the land and freshwater species had probably migrated from Europe to Canada through Northern Asia, and that most of the marine species must have been transported from the Arctic seas by Davis's-Strait current southwards to Cape Cod, and the remainder from the Mediterranean and western coasts of the Atlantic by the Gulf-stream in a northerly direction. He renewed his objection to the term "representative species."

* An abstract of a communication made by the author to the Brighton Meeting of the British Association, and now published at his request.